

## EXERCISE ANSWER KEY

### Submodule 1.1

1. In construction, what establishes the quality requirements?

The quality requirements are established by the plans and specifications.

2. What is the purpose of CQM?

The purpose of CQM is to achieve the quality established by the plans and specifications, through the cooperative but separate efforts of contractor and Government personnel.

3. Define CQM:

CQM is the performance of tasks, which ensure that construction is performed:

- according to plans and specifications,
- on time,
- within a defined budget, and
- in a safe work environment

4. What are the two principal areas of CQM activity? Define each.

The two principal areas of CQM activity are contractor quality control (CQC) and Government quality assurance (QA).

CQC is to assure that the completed project meets all quality requirements of the contract. To guide the contractor in this task, a CQC plan must be prepared to ensure that the required standards of quality construction are met. In the CQC plan, the contractor defines the procedures by which he will manage and control his:

- own activities,
- all subcontractors' activities, and

- all suppliers' activities.

QA is the means by which the Government protects its interest by assuring that CQC is working effectively and that the end product complies with the quality established by the contract.

5. What are the benefits of CQM to the contractor? To the Government?

To the contractor, the benefits of CQM are increased profit and production, better communication, planning, improved organizational skills and outstanding performance evaluations to obtain future contracts.

To the Government, the benefits of CQM are many: Work is performed according to plans and specifications, on time, within a defined budget, easily maintained, and a safe work environment. This can be summarized as “getting our money’s worth”.

6. What two factors have caused the construction industry to become highly specialized?

The two factors are:

- a changing market, and
- increased technology and regulation.

7. Why are construction projects difficult to manage?

Construction projects are difficult to manage because:

- construction projects are unique by nature making standardization difficult,
- construction operations involve many skills that are nonrepetitive skills and do not lend themselves to an assembly line approach,
- construction projects are to a large degree dependent upon environmental conditions, which are beyond the contractor’s control, and
- subject to varied regulations from numerous Government agencies.

8. What factors will influence both the Government and the construction industry in the future?

Influencing factors will be:

- new Government regulations,
- greater client/customer influence,
- improvement of QC and QA requirements,
- the increased use of construction-oriented management information systems,
- formal partnering involving all stakeholders,
- increase in contractual requirements for exchange of data in electronic format,
- increased performance-based requirements, less prescriptive,
- more reliance on design-build, and
- more consideration of life-cycle requirements as opposed to just construction.

## **Submodule 1.2**

### **1. What is the difference between INSPECTION and CONTROL?**

INSPECTION is the process by which ongoing and completed work is examined. INSPECTION is ongoing or "after-the-fact."

CONTROL is a continual system of planning activities to ensure that the contractor is properly prepared to begin a phase of work and that he follows through in accomplishing the work in accordance with the contract.

CONTROL is "preventive."

2. Who has contractual responsibility for quality control?

Contractual responsibility for quality control rests with the contractor. Although the contracting agency and the owner are vitally interested in quality control, responsibility for quality control belongs with the contractor.

3. Is the following statement TRUE or FALSE: "CQC is principally concerned with Inspection?" Explain.

The statement is FALSE. CQC is principally concerned with control.

4. How does the contractor benefit from effective CQC?

Contractor benefits are:

- reduces tear out and replacement costs stemming from deficient workmanship and materials,
- causes work to be done correctly the first time,
- greater profits,
- improves reputation and image of the contractor leading to possible future contracts,
- improved safety, which means less lost-time, fewer insurance claims, and
- pride in delivery of a quality product.

5. Name the benefits of effective CQC that accrue to the Government.

Benefits to the Government of effective CQC are:

- manpower is more effectively used,
- fewer deficiencies and corrective efforts, which may lead to an earlier completion, since there is a reduction in corrective work by contractor forces,
- improves public relations and client/customer satisfaction,
- cost and time growth are minimized, and

- produces pride in the delivery of a quality product.

### Submodule 1.3

1. What is the role and responsibilities of the contractor in CQC?

The roles and responsibilities are clearly specified in the contract documents. The contractor is required to place a competent representative, the QC Manager, on the site to oversee the QC system. The QC Manager must have full written authority to act for the contractor on all CQC matters.

2. What are the responsibilities of the contractor's QC Manager?

The QC Manager's responsibilities are:

- controlling the quality specified in the plans and specifications,
- stopping work,
- developing and maintaining an effective CQC system,
- performance of all control activities and tests, and
- preparation of acceptable documentation of CQC activities.

3. What are the QA responsibilities of the Government?

Government QA responsibilities include:

- assuring the specified standard of workmanship possible with the specified materials and within the limits of the contract.
- require the contractor to maintain the quality specified in the plans and specifications from the very beginning.

- conducting onsite business only with the contractor's QC Manager/Superintendent—should not deal directly with individual craftsmen or subcontractors, but coordinate through the prime contractor.
  - observe all activities of the CQC staff and recommend to the Contracting Officer that which require changes in the CQC organization and/or system, if the contract requirements are not being met.
4. Name the items upon which partnering relationships are based.
- Trust, dedication to common goals, understanding and assistance to reach each other's individual expectations and values.

## **Module 2**

1. Name three instances of contractor extensions of design:
  - pre-engineered metal buildings
  - fire alarm and protection systems
  - cathodic protection
2. Name some possible areas that must be addressed during the construction coordination review of plans and specifications.
  - Site conditions and restraints: Check for proper utility interface with existing facilities. Verify locations of utilities in the facility, waste disposal, site location, site survey control point, etc.
  - Proper allowance for maintenance space and access: The contractor shall prepare layout drawings of equipment to assure that adequate maintenance access has been provided.
  - Conflicts and discrepancies between plans and specifications.

3. What are the responsibilities of the QC Manager during the design phase of a design-build project?

The responsibilities of the QC Manager are to take an active role in the review and coordination of the design, to include, but not be limited to:

- Constructibility
- Operability
- Environmental
- Review of all drawings and specifications
- Coordination between different disciplines and trades to prevent any interference between different components
- Coordination with suppliers, and
- Selection of materials and equipment to assure utilities connectivity and physically fitting into provided spaces.

4. The following (4A through 4F) are extracts from specifications and drawings for a recent designed project. They all contain errors, omissions, or inconsistencies that were discovered during the review. Examine the "highlighted" area(s) of each, and indicate what clarification is needed.

Exercise	Clarification Needed
4A	Describe type and size of pole.
4B	Indicate where underground markers will be relocated and specify whether lines are to be moved or not.
4C	Describe size and thickness of concrete pad that is to be demolished and whether or not it is reinforced.
4D	Indicate the number of 25,000 and 30,000-gallon tanks.
4E	What is the size, configuration, and type of metal of the gutter and down spout.

Exercise	Clarification Needed
----------	----------------------

- 4F                      Either "TOP EL. 1774.00" or "FLOOR EL. 1776.25" must be wrong. Check other sources to determine the error, and indicate the required change on the drawing.

### **Submodule 3.1**

1. Define the Quality Assurance Plan.

The QA Plan is a Government document used as a management tool.

2. Define a Quality Control Plan.

A QC Plan is a detailed outline of the contractor's planned QC procedures. It is the foundation upon which quality work is based.

3. Name the components that must be addressed by the Quality Control Plan.

Required components of the QC Plan are:

- Table of Contents,
- QC organization, including a chart showing lines of authority, QC staffing,
- names and qualifications of individual QC personnel, this includes subcontractors and supplier personnel assigned QC duties, and assignment of a single QC manager and QC manager alternate,
- duties, responsibilities and authorities of QC Personnel, to include delegated QC duties,
- outside organizations,
- appointment letters,
- a list of definable features of work,
- procedures for performing the three phases of control,
- submittal procedures and initial submittal register,



- testing laboratory information,
  - testing plan and log to include procedures for giving advance notice to the Government for the conduct of tests,
  - procedures for tracking construction deficiencies/rework items,
  - procedures for completion inspection, and
  - documentation procedures, to include completion turnover procedures.
  - personnel matrix (NAVFAC contracts specific)
4. Name the actions that must be accomplished relative to the QC Plan before construction can begin.
- The QC Plan must be received, reviewed, and formally accepted by the Contracting Officer or their representative before construction/work can begin.
5. Name the phases of the "Three-Phase Control," and indicate when each is implemented.
- The Preparatory Phase – this phase shall be performed prior to beginning work on each definable feature of work. Use the Preparatory Phase checklist when conducting this phase meeting. Safety is a consideration.
  - The Initial Phase – this phase must be accomplished at the beginning of a definable feature of work. Use the Initial Phase checklist when conducting this phase meeting. Safety is a consideration.
  - The Follow-up Phase – daily checks shall be performed to assure continuing compliance with contract requirements. Safety is a consideration.

## **Submodule 3.2 FOR CORPS**

This is an example of a Corps QC Plan, but it is not complete. Review this plan and comment on how it could be improved to meet the contract requirements.

### **Letters of Authority and Qualifications of Personnel**

1. No organization chart of the lines of authority and CQC Personnel.
2. Although Mr. McCray is appointed to the Quality Control Position, it is not clear whether he is the Quality Control System Manager or a member of the Quality Control staff.
3. Spec paragraph 3.3.2.2 requires resumes, duties, etc., of each person assigned a QC function.
4. The Quality Control support team consisting of the superintendent and Keyes' Project Managers are designated, as CQC but resumes, etc., are not included.
5. Letter of authority did not state he had authority to stop deficient work.

### **Quality Control Plan**

1. 2.0-C (Policy) should state that notification of deficiencies begins with the foreman, then superintendent, and then Project Manager. This should not occur because all people should know that the CQC has the authority to reject non-compliant work.
2. 3.1 (Quality Control System Manager) yet another term without contractual meaning further confusing the CQC staff. We still do not know who the CQC system manager is.
3. 3.2 (Contractor's other personnel) The Government should review and approve whether the contractor's superintendent is qualified or has time to function as CQC staff.
4. 4.1-A (Preparatory Phase) Contract specifications require a review of contract plans.
5. We find no evidence of Government approval of CQC test lab.

6. The Daily report has no space for "Visitors Today".
7. No list of QC tests is provided.

### **Submodule 3.2 FOR NAVY**

This is an example of a NAVY QC Plan, but it is not complete. Review this plan and comment on how it could be improved to meet the contract requirements.

This QC Plan is provided in the standard Corps and Navy QC Plan format per specifications for Quality Control, 01451 (Corps) and 01450 (Navy).

1. In Tab I, The Organizational Chart indicates a superintendent. He is not part of the QC organization, but is provided for clarification and to show the production side of the contractor's organization.
2. In Tab II, The resumes for the QC Manager (QCM) and the Alt-QC Manager (Alt-QCM) do not provide enough detailed experience. Suggest more information be provided before acceptance. There is no QC Certificate for the QCM or Alt-QCM. The QCM and Alt-QCM must have this training and include copies of the certificates. Watch for the expiration date of the certificates; they are valid for five years from date of issue. There are no resumes provided for the two QC Specialists. These resumes are required.
3. In Tab III, The Duties, Responsibilities and Authority of the QC Personnel; for the QCM and the Alt-QCM, are very short. Provide more detailed information as described in the specifications. Provide the same for the QC Specialists; none was provided.
4. In Tab IV, Outside Organizations, five companies are indicated, but no description of the services they are to provide. Please provide! No consulting Engineering firms were indicated. Who is the official Submittal reviewer and approver? Provide required information.
5. In Tab V, The Appointment Letters for the QCM and the Alt-QCM are provided. These are good examples of appointment letters since they include the requirements of the specification.
6. In Tab VI, The Submittal Procedures are provided. However, no Initial Submittal Register is provided. Please provide.
7. In Tab VII, The Testing Laboratory Information required by paragraphs entitled "Accreditation Requirements" is provided. However, no specific

8. information or Accreditation for “Soils Testing, Inc.” is provided indicating the company is an Accredited Lab with the Corps of Engineers, NVLAP or with AASHTO. Please provide the certification letter, as required. Also provide additional testing information per the specifications for: Steel Testing, Mechanical Testing, Controls Testing and Electrical Testing.
9. In Tab VII, The Testing Plan & Log standard form is provided. However, it is not filled out. The Log must be filled out for all Testing required by the technical specifications.
10. In Tab IX, The Procedures to complete Rework Items appears OK. Use of the standard Rework Items List is also good.
11. In Tab X, The Documentation Procedures for Quality Control and Production are provided and appears OK. Use of the standard Navy forms is also good.
12. In Tab XI, The List of Definable Features of Work (DFOWs) is provided. The tracking form and List of DFOWs for this example contract appears very good.
13. In Tab XII, The procedures for performing the three phases of control are provided and look good. Use of the standard Preparatory & Initial Phase Checklist also looks good.
14. In Tab XIII, The Personnel Matrix indicating who in the QC organization will review and approve submittals, who will perform and document the three phases of control, and who will perform and document testing is provided and is very good.
14. In Tab XIV, The Completion Inspection process is provided and also looks good.

#### **Module 4**

1. What is the objective of the Post-award Orientation Conference/Preconstruction Conference?

The objective of the Post-award Orientation Conference/Preconstruction Conference is the review the contract clauses to include accident prevention, administrative requirements, personnel requirements, and procedural matters.

2. Why is the Post-award Orientation Conference/Preconstruction Conference important?

The Post-award Orientation Conference/Preconstruction Conference is important because it establishes the ground rules for administering the contract.

3. Who schedules, convenes, and conducts the Coordination and Mutual Understanding Meeting?

The meeting is scheduled, convened, and conducted by the Government. Normally, this is the area, resident, or project engineer or the SGE, AROICC/AREICC and QA Representative.

4. What are the primary purposes of the Coordination and Mutual Understanding Meeting?

There are three primary purposes of the Coordination and Mutual Understanding Meeting:

- a. to achieve a mutual understanding with the contractor of his role in quality control,
  - b. to review the QC Plan with the contractor, and
  - c. to establish a good working relationship between the Government and the contractor.
5. Who attends the Coordination and Mutual Understanding Meeting?

Attendance to the Coordination and Mutual Understanding Meeting should include all Government, contractor, and subcontractor personnel who will be involved in construction quality management.

## **Module 5**

1. What is the purpose of submittals?

Submittals are required by the contract in order to regulate the timely flow of materials to be incorporated into work. All required submittals must be provided in time to allow for review, approval, procurement, delivery, and performance of the preparatory phase of the Three Phases of Control for an item before it is needed for construction. Submittals are indispensable

in assuring and controlling construction quality and must be given the attention required.

2. What is the process the contractor must use to request a variation?

Variations must be noted on ENG Form 4025 and fully described, identified, and justified in the transmittal package.

3. What are the contractor's submittal responsibilities?

The contractor's responsibilities are:

- to integrate the submittal process into his QC Plan and delegate submittal responsibilities to the proper individuals on his staff,
- to be aware that the Government considers the handling of submittals to be important,
- to ensure that all submittals are in full compliance with the contract,
- to review the Government prepared Submittal Register and add any needed additional submittals, for design-build projects, the designer of record prepares the submittal record,
- to check the submittal schedule requirements against the NAS or other approved construction schedule,
- to maintain and adjust dates on the register as required by the contract activities to ensure the document reflects current information,
- to ensure that all variations must be fully described, identified, and justified in the transmittal package,
- to assure that work is not permitted to begin without properly approved submittals, and
- to ensure compliance with the "Buy American Act - Construction Materials."

4. What are the Government's submittal responsibilities?

The Government's responsibilities are:

- to prepare a list of submittals (on ENG Form 4288) required for each contract, for design-build contracts, the designer of record identifies the

required submittals in the specifications and prepares the submittal record,

- to review a minimum of 10% of . For Information Only submittals,
- to review and approve submittals that require Government Approved (GA), and
- to enforce submittal requirements.

5. What information must the contractor provide in his submittal control document (ENG Form 4288 - Submittal Register)?

The following information must be provided by the contractor in the submittal control document (ENG Form 4288 - Submittal Register):

- the item number,
- the contractor schedule dates,
- the contractor action, and
- NAS Activity Code, when applicable.

### **Submodule 6.1**

1. What is the primary function of QA?

The primary function of QA is to obtain completed construction that meets all contract requirements.

2. What is the role of QA personnel?

The role is to assure that the CQC system is functioning properly.

3. What is the primary function of CQC?

The primary function of CQC is the successful execution of a realistic plan to ensure that the required standards of quality construction will be met.

4. What are the roles of QC personnel?
  - produce the quality specified in the plans and specifications, and for design-build contracts in the Request for Proposal, as well as the contractor's accepted proposal,
  - develop and maintain an effective CQC system,
  - perform all control activities and tests, and
  - prepare acceptable documentation of CQC activities.
5. For design-build contracts, what additional requirements must be included in the QC Plan?
  - Provide and maintain a Design Quality Control Plan as part of the overall QC Plan
  - A technically competent, independent reviewer specifically named in the plan must perform review of all documents
  - Management of the Design QC Plan shall be by a Design QC Manager who has verifiable engineering or architectural design experience or is a registered engineer or architect, and
  - The QC Manager performs supervision of the Design QC Manager.

## **Submodule 6.2**

1. What is the primary purpose of the three-phase control system?

The primary purpose of the three-phase control system is to require the contractor to plan and schedule the work to ensure that he is prepared to start each new feature of work.
2. Regarding the three-phase control system, what are the responsibilities of quality control personnel?
  - Develop, schedule, and implement procedures for tracking control phase meetings for definable features of work in the QC Plan,
  - Notify appropriate personnel of time, date, and agenda,
  - Conduct meetings (Preparatory and Initial),



- Safety considerations and Activity Hazard Analyses (AHAs),
- Document actual discussions and provide minutes to attendees,
- Monitor work in place through follow-up phase,
- Conduct additional control phase meetings, as needed.

### **Submodule 6.3**

1. What are the major components of the sample Quality Control Report in submodule 3.2.

Major components of the sample Quality Control Report are:

#### **CORPS**

- type of construction underway,
- phase of the feature of work,
- locations and times of control activities,
- tests performed and results,
- submittal information,
- arrival of equipment and materials,
- offsite surveillance, and
- job safety.

#### **NAVY**

- type of construction underway identified by schedule activity numbers,
- phase of the feature of work, preparatory phase activities, initial phase work, follow-up phase work,
- locations and times of control activities,
- tests performed and results,
- offsite surveillance,
- rework items identified/ corrected this date,
- job safety complies with safety plan,
- QC Manager's certification, signature and date

2. How often are Quality Control and Quality Assurance Reports required?

Quality Control Reports are required daily; Quality Assurance Reports are required for each visit day.

3. Following (3a through 3e) are situations relating to documentation and three-phase control. Read the situations carefully, and respond to the requirement(s) accompanying each.

- a. The G. J. Company has a contract for rehabilitation of three barracks. The work consists primarily of addition of partitions and installation of A/C equipment and ductwork. On the day duct work installation started, the Daily Report stated: "Started installing duct work today. Everything looked okay." Is this report feature adequate? EXPLAIN.

NO! Following points should be recorded:

- (1) Were preparatory and initial phase meetings conducted and, if so, results of those meetings?
- (2) Location of work accomplished.
- (3) "Okay" is not a satisfactory explanation of contract compliance.
- (4) Who is doing work? Subcontractor?
- (5) What type of ductwork?

- b. The G. J. Company continues work on rehab contract. Today's activities involve the continuation of insulating ductwork. After several review sessions with the contractor with regard to proper documentation of activities, his comments were, "Insulation of duct work being done in accordance with specifications. Vapor barrier was ripped in a couple of places and insulator was a little light in use of staples." Rewrite the contractor's comments to make them acceptable.

Following items should be included in the comments:

- (1) location of work,
- (2) reference to review sessions,
- (3) was ripped vapor barrier repaired and how?
- (4) were additional staples added? and

- (5) actions taken to prevent recurrence.
- c. The Paw Power Construction Company has a contract for construction of a high-rise administration building. Work was in early stages of construction and a subcontractor had just completed backfilling sanitary sewer lines. The utilities sub foreman had been designated as QC Manager for this portion of the work. His report was attached to the main report. A preparatory and initial phase had been performed and recorded earlier. This report stated, "All work completed in accordance with directions received at preparatory phase."
  - (1) Is it permissible to accept sub reports attached to the Daily Report? Yes. This should be discussed at the Coordination Meeting.
  - (2) Is it permissible to reference preparatory phase? Yes, but date of preparatory phase should be noted to facilitate correlation.
  - (3) Is anything missing? Location of work. Reference to specification requirements as well as preparatory phase. Test results of required tests.
- d. Results of Surveillance: Bowers installed base of manhole #2 approximately 10 ft. east of its correct location. Pipe between manholes #6 and #2 is being removed and the pipe between manholes #3 and #2 is being extended to new location for manhole #2.
  - (1) What does this report say?
  - (2) Rewrite the report so that it states clearly what is intended.

The lack of sufficient detail in this report leaves you wondering as to exactly what happened and what corrective action was taken. The statement would cause you to believe that manhole #2 was left in the incorrect location and the lines extended accordingly. Actually, what the contractor was attempting to state was that he removed the mislocated manhole #2 base and installed all structures in their proper location. Misunderstandings such as the above are not uncommon because of the lack of clarity in QC Reports.
- e. You are the QC Manager. You are to begin installation of ceramic floor and wall tile. Both the floor and the wall are to receive a setting bed.

The floor has floor drains and waterproofing has been completed. The wall has electrical receptacles.

(1) Who would you want at the Initial Phase of the work?

- Tile foreman and craftsmen.
- Electrical subcontractor representative.
- Mechanical subcontractor representative.
- General contractor representative.

(2) What would you check?

- Previous work on floor and wall substrates,
- Quality of waterproofing,
- Floor drain location and elevation,
- Electrical receptacle installation,
- adequacy of ceramic tile materials including tile, mastic, mortars etc.
- Do the craftsmen understand the contract requirements.

(3) What items should be contained in the QC Report covering the Initial Phase?

Remembering previous discussions on the initial phase, the QC Report should cover the following, at a minimum:

- attendees,
- inspection of preliminary work,
- safety,
- establishment of level of workmanship, and
- resolution of any discrepancies raised.

## Submodule 6.4

### 1. Define QC testing.

QC testing is that testing performed by the contractor to determine whether construction procedures and materials are producing the desired contractual product.

### 2. Define QA testing.

QA testing is that testing performed by the Government to verify that QC testing is adequate.

### 3. Who performs QC tests?

The contractor may use his own personnel and facilities or may employ an independent approved testing laboratory.

### 4. Who performs QA tests?

QA tests can be performed by:

- Government personnel using the contractor's equipment and facilities.
- an independent testing laboratory, or
- field office, district or division Government laboratory.

### 5. What questions should be answered before testing begins?

- has all required testing been identified?
- Are test reporting requirements understood?
- Have laboratory facilities and testing equipment been verified as acceptable?
- Are laboratory personnel qualified?
- has the calibration of equipment been verified as accurate?
- is there a procedure for documenting corrective steps?

## **Submodule 6.5**

What is the appropriate chronological order for quality management completion procedures listed in this submodule? Explain.

1. Warranty - Documentation of warranties, if any, are provided to the Government at submittal time.
2. O&M Manuals - Instruction on preparation of equipment must be obtained and understood prior to turning it on. Likewise, if equipment is to be operated correctly, the recommended maintenance of it is necessary to obtain its maximum life.
3. Testing of Completed systems - Mechanical and electrical systems must be proof-tested to prove or ensure such systems will function as intended.
4. Instruction and Training Procedures - After systems have been proof-tested, proper operation and maintenance of systems is demonstrated to customer O&M personnel utilizing previously prepared manuals.
5. Contractor Punch-Out - Procedure required for entire project or portions thereof prior to pre-final inspection.
6. Pre-Final and Final Inspections - Procedures required for acceptance of a project or portions thereof by the Government.
7. Materials Turnover - Executed at the time of turnover of acceptable work to the customer.
8. As-Built Drawings - Created throughout the life of the project, but provided to the Government at completion.

## **Module 7**

1. Name the categories of problems that normally occur during construction.

Problems during construction normally fit into the following categories:

- delays,
- planning and control,
- testing,
- documentation, and

- misunderstanding of CQC responsibility.
2. What options are available to the Government under the Contract Clauses of the contract?

Government options are:

- Requiring the contractor to remove and replace deficient materials and/or workmanship.
  - Withholding payment.
  - Requiring removal of unqualified personnel.
  - Requiring the contractor to assume personal supervision.
  - Halting work.
  - Issuing an unsatisfactory performance appraisal.
  - Terminate the contract.
3. Analyze the cases on the following pages and answer the questions included with each. Be prepared to discuss your answers with other members of the class.
- a. Contractor is constructing a commissary. The contract was awarded in April, which allowed for sufficient time to enclose the building before onset of cold weather. Building is scheduled to be complete in May of next year, which necessitates doing the inside finish work during winter months. The customer has scheduled delivery of equipment and stock for June. Work was progressing satisfactorily and the contractor was about to start roofing operations in mid-September when the resident engineer discovered the contractor was installing untreated lumber for edge strips, curbing, etc., which was in violation of the specifications. Work was stopped, and after some investigation, contractor advised the resident engineer that the best delivery on treated lumber was eight weeks, which would delay enclosing the building and ultimately delay turnover to the customer. The contractor requested waiver of treated lumber requirement.
- (1) Where did the contractor's control system break down?  
Obviously an effective Preparatory Phase meeting should have addressed the subject of "treated lumber" as this has been

historically a repetitive problem in roofing operations. Further, the specifications usually require certain contractor submittals on treated lumber. Therefore, the contractor's CQC system failed from the absence of, or an inadequate Preparatory Phase meeting.

(2) Where did the Government assurance system break down?

The Government's system broke down when by not assuring that the contractor had conducted a proper Preparatory Phase. Further, it should have been noted from an examination of the contractor's QC reports the lack of this important phase. Also, the Government failed to monitor the submittal register.

(3) What are the resident engineer's courses of action?

Pursuant to the terms of the contract, the resident engineer must now reject the improper material and require contract compliance. The resident engineer should also question, in writing, the adequacy of the Contractor's Quality Control system and require immediate management corrective action.

- b. Contract involves construction of a major barracks complex including 25 dormitories. Project is 75% complete and occupied by troops when the customer complains that the opaque panel in lower window section is allowing precipitation to penetrate during driving rain. The leaks have stained carpet and ceiling tile. Investigation reveals that leaking panels are improperly glazed and do not conform to the contract drawings or specifications. All windows had been factory glazed and were warehoused onsite. Although a vinyl strip covered the glazing, careful examination of the windows prior to, and after installation would have revealed the construction deficiency.

(1) Identify the steps within the CQC system that failed, thereby creating the construction deficiency.

There was an absence of, or inadequate, Preparatory Phase meeting, which would have included examination of materials and comparison to shop drawings when materials were delivered to the jobsite. Because of the volume of windows involved, CQC directly related to offsite fabrication should have been addressed during the Coordination Meeting. A visit by the contractor to the fabricator's plant during the fabrication process would have been in order.



- (2) Identify the steps within the Government's QA system that failed to detect the breakdown in the contractor's QC system.

The Government did not assure itself that the contractor had scheduled or conducted a Preparatory Phase. The Government representative conducting the Coordination Meeting did not address the subject of offsite fabrication or examination of materials or equipment when delivered to the project site. QC Report review by QA personnel should have revealed lack of adequate Preparatory Phase.

- (3) Keeping in mind that there are 4,200 windows involved in the contract, what corrective measure should the resident engineer employ?

Contractor should be immediately advised in writing, by the Contracting Officer's Representative to cease installation of windows until compliance with the contract is demonstrated. Problem is of such a magnitude that Contract Clause, "Inspection of Construction," will be invoked formally to require the contractor to examine and expose an adequate sampling of windows throughout the project. It is possible the Government may be liable for some payment if the examination reveals some contract ambiguity, but the severity of the problem is such as to warrant the risk.

- (4) What action should be taken on remaining buildings not completed?

The contractor should be required to immediately convene a Preparatory Phase meeting and all aspects of the window installation should be reviewed by the contractor in detail before any further work on this feature progresses. The contractor should be required to increase his QC surveillance until he demonstrates contract compliance.

- (5) Assume, because of the magnitude of the problem, that the contractor and window manufacturer refuse to comply with your directive; what tools in the contract does the resident engineer resort to?

The contractor should again be directed in writing by the Contracting Officer to correct the defective windows. A definite suspense date should be established in this letter for effecting the correction. The contractor should be advised that if correction is not accomplished by that date, pursuant to the contract, another

contractor will be employed to make the correction and he will be backcharged for the cost. Further, a copy of this correspondence should be forwarded to the contractor's surety company. Many times, this generates immediate action. Reference to the payment Contract Clause and the Contractor Performance Appraisal may also create some activity on the contractor's part.

- c. Contract is for a large barracks complex involving 47 buildings. There are 1,500 fan coil units to be installed throughout the project. As the fan coil units were delivered to the site, the mechanical subcontractor discovered that the units contained a 1/2" valve in lieu of a 3/4", as indicated on the contract drawings. Contractor's shop drawings also indicated a 3/4" valve. Contractor immediately advised the resident engineer of the discrepancy. Contractor further advised that supplier's standard unit is furnished with a 1/2" valve and requested permission to use units as delivered. All units were delivered in one large shipment, and some were needed for immediate installation.

- (1) Was the subcontractor's quality control system working?

The subcontractor's quality control system was working. He had examined equipment immediately upon delivery to the job site and advised the prime contractor. However, the subcontractor might have visited the supplier's plant during fabrication because of quantity involved.

- (2) Where does the supplier fit into the problem?

The failure rests with the supplier for not correlating the shop drawing with the manufactured item. Again, because of the magnitude of the order, there should have been a closer communication between the supplier and the subcontractor. This is a breakdown in QC. The prime contractor is ultimately to blame for not fulfilling the responsibility to assure the subcontractor and the supplier were communicating.

- (3) What measures should Government QA personnel now employ?

QA personnel should instruct the contractor not to install any of the units until the problem is resolved.

- (4) In this instance, should the resident engineer investigate possible design error in specifying a 3/4" valve?

The resident engineer should investigate the possibility of a design error as the Government normally specifies a manufacturer's standard unit. If a drafting error on the plan is discovered as the cause, a modification should be issued changing the 3/4" valve to 1/2" with an equitable credit to the Government.

This case study demonstrates that each problem that arises must be judged carefully.

- d. Project includes several masonry buildings requiring joint reinforcement. Contractor proceeded with sample masonry panel erection without approved materials despite Government QA personnel objection. Contractor has now completed wall erection on one building and Government QA personnel discover the contractor is using wrong joint reinforcement. Contractor superintendent states bar joists will be erected tomorrow morning.

- (1) What questions first come to mind as to the effectiveness of the contractor's quality control system?  
Obviously, the contractor has not employed an effective CQC system since the start of the project. Deficiencies such as depicted do not occur if proper preparatory phase was conducted.

- (2) Where did the Government's quality assurance role first break down?

Basically, the Government has failed in its Quality Assurance role by allowing the contractor to progress to this point without an effective CQC system. Government QA personnel have not employed the contractual remedies available to correct the situation before it deteriorated this far.

- (3) What Contract Clauses should be employed by the resident engineer at this point in time?
  - (a) Direct the contractor under the "Inspection of Construction" clause to cease masonry work until work has been corrected.
  - (b) Under the "Withhold Payments Contract Payment" clause withhold payment for any deficient work.
  - (c) Under the "Material and Workmanship" clause remove the contractor's QC representative as incompetent.

The contractor should be advised of all of the above in writing over the Contracting Officer's signature. The contractor should also be told that the resident engineer is considering the issuance of an interim unsatisfactory performance appraisal if improvement to the CQC system is not initiated.

- e. Project is a small flood control dam with reinforced concrete outlet structure. Contractor testing requirements are specified in detail, and require full-time quality control personnel at concrete batch plant. Concrete production has commenced, and after one week concrete cylinder breaks indicate extremely low compressive strength. It is immediately discovered that the plant measuring devices had not been calibrated.

- (1) What is the Government's first corrective action to be taken?

The Government must direct contractor to stop placement of concrete.

- (2) What apparent deficiency existed in the contractor's quality control system?

Lack of an adequate Preparatory Phase, which would have addressed calibration of the plant.

- (3) Basically, where did the Government quality assurance role fail?

Lack of an adequate Coordination Meeting, which should have addressed calibration and testing, in general. It is apparent also that the Government had not insisted that the contractor conduct a Preparatory Phase meeting prior to the start of concrete operations.

- (4) What Contract Clauses must now be employed by the Government?

- (a) Require the contractor to demonstrate strength of concrete in place. If found deficient, require removal and replacement. (CC "Inspection of Construction")
- (b) Withhold all payment for placed concrete until situation is corrected. (CC "Withhold Payment - Contract Payment")
- (c) Caution contractor on competency of his QC representative. (CC "Material and Workmanship")

- f. On an underground electrical distribution project, the contractor was to install a run of 2/0 cable in the system. The project had been completed and accepted two years ago, when it was discovered that this run of cable was #2 instead of 2/0 and totally inadequate for the future load.

- (1) What corrective measure, if any, is available to the Government to have the deficient cable replaced?

The Contract Clause "Inspection of Construction," states that acceptance shall be final and conclusive except for latent defects, fraud, gross mistakes amounting to fraud, or the Government's rights under any warranty or guarantee. In this instance, this deficiency falls within the category of a gross mistake. Contractors should be required to replace cable. Contractor's surety should be notified if contractor contests action.

- (2) Should the contractor's quality control system and Government's assurance system prevent isolated instances of this type? How?

If a proper Initial Phase had been conducted, a problem such as this could have been avoided. Further, the Follow-Up Phase should have revealed the deficiency.

- g. The contract for construction of the outlet works at a flood control and recreation reservoir required steel gates. The prime contractor to a fabricator in Los Angeles subcontracted the gates. All CQC requirements on the gates were delegated to the fabricator. The resident engineer arranged for Government periodic QA visits to the plant. The plant inspector advised the resident engineer that the welding procedures and the welders had not been certified prior to commencement of fabrication. The QC report contained no entry on this subject.

- (1) In this instance, what role does the prime contractor assume?

In this instance, the general contractor assumed a QA role as he has delegated the CQC responsibility to the fabricator.

- (2) Where did the prime contractor fail in the quality control system?

He no doubt did not outline the CQC requirements to the fabricator and in his QA role did not follow-up on the CQC procedures at the plant.

(3) Where did Government's QA role break down?

During the Coordination Meeting the subject of offsite fabrication was not thoroughly discussed so that the prime contractor fully understood his role. The Government may have also noted the deficiency through a proper review of the daily QC reports.

(4) What steps does the Government take now?

The Government must direct the contractor to cease fabrication until all required procedures have been met. Require the contractor to demonstrate contract compliance on previously fabricated work. Withhold payment on gates until contract quantity is satisfied.

- h. The contract was for construction of multipurpose classrooms at the Air Force Academy. The rooms were to receive carpet that had been color-coordinated with the room furnishings. Carpet was scheduled for delivery August 1, which allowed only three weeks for laying and completion of project prior to start of classes. Carpet was delivered August 1, and it was immediately discovered that the carpet did not adequately match the approved sample.

(1) Could the CQC system have prevented this? How?

Yes. If offsite fabrication and CQC requirements related thereto had been properly addressed, the prime contractor would have assured himself that the match was satisfactory during manufacture.

(2) Did the Government fail in its QA role by not inquiring as to the status of carpet manufacture?

Yes. In the Government's QA role, it should continually question the contractor as to the status and quality of his offsite fabrication and procurement.

(3) What steps should the Government take now?

Reject the delivered carpet and insist on compliance. Coordinate the delay with the customer and reschedule carpet laying outside class hours to avoid conflict.

- i. Contractor on a major multi-building project started his first concrete placement this morning. Contractor is placing a monolithic foundation using a leased concrete pump truck. Two-thirds of the foundation had been placed when the concrete pump failed. No standby placement equipment was available as required by the contract, which created a cold joint before the pump could be repaired.

(1) What was the first step that failed in the contractor's QC program?

Total lack of Preparatory Phase and Initial Phase on concrete placement.

(2) How could the Government's QA role have prevented this incident?

In the Government's assurance role they should know whether the contractor is following the three-phase control system on definable features of work. The lack of a Preparatory Phase meeting on concrete should be discovered when examining the contractor's QC reports, as these significant events should be recorded.

(3) Would proper QC reports alert us to a failure of this type in the system?

Yes, the contractor should record all Preparatory Phase minutes.

(4) What corrective measures should the Government employ to prevent further incidents of this type?

Require the contractor to cease concrete operations until alternate equipment is available; require the contractor to convene Preparatory and Initial Phase meetings and thoroughly discuss all aspects of concrete placement. Review QC Report requirements with the contractor insisting that the three-phase system of control be recorded properly. Question the effectiveness of the contractor's QC representative.

- j. An airfield project involved placement of a concrete apron for helicopters. The specifications required the use of jet fuel-resistant joint sealant. The sealant was required to be Government tested and approved prior to use. The specifications further required that the joints be sealed immediately after the curing period. Contractor started placement of concrete when it was discovered that the sealant had not been submitted for testing.

- (1) In what meeting should the testing requirements of the contract be discussed in general?

The Coordination Meeting.

- (2) At what phase should this specific testing have been discussed?

The Preparatory Phase meeting should address specific testing on the definable feature of work.

- (3) Within the Government's QA role, where should it have detected this deficiency?

The Government should have noted the lack of an adequate Preparatory Phase meeting. Its review of the contractor's QC Reports should be alerted to this problem. The review of the submittal register status should also reveal the deficiency.

- (4) What corrective measures do we use now?

Cease concrete placement until the contractor demonstrates how he will satisfy contract requirements on future placement. Explore with the contractor the possibility of his voluntary use of a temporary seal on concrete previously placed until proper material has been tested. Ensure that any temporary seal is at no additional cost to the Government.

### **Submodule 8.1**

1. What is the Corps' standard software package used on construction projects?

The Resident Management System (RMS)

2. What are the benefits of RMS?

- Reduce input,
- Merges data drawn from the RMS and QCS databases to produce useful tools to perform QC and QA functions, and
- Provides reports for key suspense items and data.



3. What are the major output products of RMS and QCS?

- Preconstruction Conference and Coordination Meeting Minutes and agenda,
- Submittal Registers, Submittal Tracking, and completed (filled-in) Transmittal Forms,
- Three-Phase Control checklists, agenda, and meeting minutes,
- A Deficiency Tracking System,
- Daily QC Reports and QA Reports, and
- Various Closeout Documents (including Installed Property, Transfer Property, User Schooling, etc.).

**Submodule 8.2**

What are three major QC components in RMS?

- Three-Phase Control agendas and databases,
- Submittal Process in RMS and QCS, and
- QC Deficiency Tracking System.

**Module 9**

1. What are the benefits of using WebCM?

The benefits of using WebCM are:

- Usage of Industry's cutting edge software technology.
- Instant upgrades that are transparent to the user.
- Reduced response time on RFIs, Submittals, etc.
- Enhanced project communication between all project stakeholders.
- Real time project status management and data retrieval.

- Better visibility of projects to Navy clients.
- Better visibility to Contractor & Government Senior Management.
- Reduced administration expenses.
- Real time collaboration and problem solving.

2. List the major CQM output products of WebCM:

- Submittal Register, submittal tracking (date/time stamping in GMT time).
- Three-Phase Control checklists, agenda, and meeting minutes.
- Deficiency tracking system.
- Daily QC and QA Reports.
- Daily Production Reports.
- Schedule Integration throughout system for data retrieval and report writing.
- Central storage area for all CQM and Production documents.